

1 Attorney Docket No. TECT-1

2

3 FLUID FLOW TRANSDUCER MODULE AND ASSEMBLY

4 CROSS-REFERENCE TO RELATED APPLICATION

5 This application claims the benefit of U.S. Provisional
6 Patent Application Serial No. 60/393,288, filed July 2, 2002 in
7 the name of David R. Dussault.

8

9 BACKGROUND OF THE INVENTION

10 1. Field of the Invention

11 The invention relates to fluid flow transducers and is
12 directed more particularly to a fluid flow transducer module which
13 is adapted for combining with other such modules of similar
14 structure to provide a fluid flow transducer module including a
15 stack of modular modules including a selected number of flow
16 transducers.

17 2. Description of the Prior Art

18 In the fluid chiller and fluid conditioning systems arts, a
19 common requirement is to measure the fluid flow rate in various
20 parts of recirculating loops, which may be many in number. The
21 flow measurement often is done electronically by means of off-the-
22 shelf flow transducer technologies. The devices produce an
23 electronic signal, of a type selected from known various types,
24 which is interpreted by a control system and the fluid flow value
25 is displayed or retransmitted for monitoring purposes. In some

1 cases, this signal is used internally as feedback in a control
2 loop for controlling flow in the process channel or device.

3 The aforementioned single-channel flow transducer devices are
4 available in a wide range of flow ratings, employing several
5 sensor technologies, and are available from many manufacturers.
6 Often fluid chillers and/or conditioning systems require
7 monitoring of multiple flow channels. This has typically been
8 accomplished by off-the-shelf single-channel flow transducers
9 assembled, usually in a parallel flow pattern, with a variety of
10 plumbing fittings, tubes and hoses in some sort of manifold
11 arrangement.

12 Although the arrangement of such standard devices has been
13 functionally correct, building the manifolds has been very labor-
14 intensive, particularly as the number of flow channels increases.
15 In some cases, custom-machined parts and fittings are required to
16 achieve the desired connection type and size the conditioning
17 system requires, which, in itself, is usually expensive. The
18 large number of parts and fittings, and associated manufacturing
19 and installation labor, may be reduced by consolidating such parts
20 and fittings and by integrating their functionality into a multi-
21 channel flow transducer unit. However, the fully integrated unit
22 itself tends to be expensive and, once developed, is difficult to
23 adapt to other applications.

24 Each multi-channel configuration typically requires a custom
25 design and custom tooling, including special molds, for each

1 unique application. If a 4-channel "module" is required for one
2 particular project, a custom 4-channel mold must be utilized. If
3 there is a future requirement for a 6, 8 or 10 channel flow
4 transducer, each subsequent variation requires further development
5 and custom tooling costs, which for relatively low-volume
6 applications can be cost prohibitive.

7 There is an increasing demand in the market for fluid
8 chillers and/or conditioning systems, for overall cost reduction
9 and, concurrently, for varied and numerous combinations of needs
10 for fluid flow measurement.

11

12 SUMMARY OF THE INVENTION

13 An object of the invention is, therefore, to provide a low-
14 cost flow transducer module which can be combined with other
15 similar modules to provide custom flow transducer assemblies which
16 reduce the physical space required for the transducers and
17 associated piping, improve manufacturability, reduce assembly
18 labor, and improve overall reliability, functionality and
19 serviceability of the system.

20 With the above and other objects in view, a feature of the
21 present invention is the provision of a fluid flow transducer
22 module comprising a fluid flow conduit having an inlet for
23 receiving fluid from a fluid discharging apparatus, a transducer
24 associated with the conduit for measuring rate of flow of the
25 fluid through the conduit, and an interface in communication with

1 the transducer and adapted to receive rate of flow measurements
2 from the transducer and to effect at least one of (i) a display of
3 measurements to an operator, (ii) a remote monitoring of
4 measurements, and (iii) a corrective signal for modifying the
5 rate of flow. The fluid flow conduit is provided with an outlet
6 for flowing the fluid from downstream of the transducer to a
7 reservoir for the fluid, the outlet extending transversely of the
8 conduit. The invention further comprises a housing for the
9 conduit, conduit inlet, conduit outlet, and transducer, the
10 housing having opposed first and second walls, each of the walls
11 having an opening for the outlet therein. At least one of the
12 walls is adapted for stacking engagement with a second fluid flow
13 transducer module of a substantially same structure, such that the
14 outlets of the module are aligned to form portions of a common
15 conduit.

16 In accordance with a further feature of the invention, there
17 is provided a fluid flow transducer module comprising first and
18 second fluid flow transducer modules. Each of the modules
19 comprises a fluid flow conduit having an inlet for receiving fluid
20 from a fluid discharging apparatus, a transducer associated with
21 the conduit for measuring rate of flow of the fluid through the
22 conduit, and an interface in communication with the transducer and
23 adapted to receive and act on rate of flow measurements from the
24 transducer. The fluid flow conduit is provided with an outlet for
25 flowing the fluid from the transducer to a reservoir, the outlet

1 extending transversely of the fluid flow conduit. A housing is
2 provided having opposed first and second walls, each of the walls
3 having an opening for the outlet therein, at least one of the
4 walls of the first module being adapted for stacking engagement
5 with at least one of the walls of the second module. The first
6 and second modules are joined together at the one walls to form
7 the fluid flow transducer assembly, and the fluid flow conduit
8 outlets are thereby aligned to form a common conduit in
9 communication with a reservoir for the fluid.

10 In accordance with a still further feature of the invention,
11 there is provided a fluid flow transducer assembly comprising a
12 plurality of transducer modules fastened together in stacked
13 fashion, each of the modules having a fluid flow conduit in
14 communication with a fluid source, a flow rate measuring
15 transducer for measuring flow rate through the flow conduit, and
16 an outlet for flowing fluid from the flow conduit out of the
17 module. The outlet of each of the modules extends through the
18 module from one side to another, and a collar member is disposed
19 at one end in the outlet of a first of the modules and at a second
20 end in the outlet of a second of the modules to align the first
21 and second modules. The outlets and the collar members form a
22 common outlet conduit for the modules.

23 The above and other features of the invention, including
24 various novel details of construction and combinations of parts,
25 will now be more particularly described with reference to the

1 accompanying drawings. It will be understood that the particular
2 devices embodying the invention are shown by way of illustration
3 only and not as limitations of the invention. The principles and
4 features of this invention may be employed in various and numerous
5 embodiments without departing from the scope of the invention.

6

BRIEF DESCRIPTION OF THE DRAWINGS

8 Reference is made to the accompanying drawings in which are
9 shown illustrative embodiments of the invention, from which its
10 novel features and advantages will be apparent.

11 In the drawings:

12 FIG. 1 is a diagrammatic, generally sectional, partly broken-
13 away view of one form of fluid flow transducer module illustrative
14 of an embodiment of the invention;

15 FIG. 1A is similar to a portion of FIG. 1, but illustrative
16 of an alternative embodiment of fluid flow transducer module;

17 FIG. 2 is an exploded view of five modules of the type shown
18 in FIG. 1:

FIG. 3 is a perspective view of the modules of FIG. 2

20 fastened together in stacked relationship to form a fluid flow
21 transducer assembly illustrative of a further embodiment of the
22 invention:

23 FIG. 4 is a perspective view of the assembly of FIG. 3, and
24 illustrating an alternative embodiment in which each module is
25 provided with two side-by-side fluid flow conduits; and

1 FIG. 5 is a perspective view of the assembly of FIG. 4 shown
2 mounted on a fluid receiving, monitoring, treating and recycling
3 apparatus illustrative of an exemplary use of the invention.
4

5 DESCRIPTION OF THE PREFERRED EMBODIMENTS

6 Referring to FIG. 1, it will be seen that an illustrative
7 fluid flow transducer module 10 includes a fluid flow conduit 12
8 having an inlet 14 for receiving fluid from a fluid discharging
9 apparatus, such as a chiller or other fluid conditioner (not
10 shown). The conduit inlet 14 is adapted, as by threads 16, or
11 other connecting means, to receive an external pipe or hose
12 adapter fitting connection 18 (FIG. 2), to effect delivery of the
13 fluid flow to the conduit inlet 14 of the flow transducer module
14 10.

15 The module 10 further includes a transducer 20 (FIG. 1)
16 associated with the conduit 12 in known fashion to effect
17 measurement of the rate of flow of the fluid therethrough. In an
18 illustrative transducer, a wheel, or propeller blade 21, is turned
19 by the moving fluid and has fixed thereto a magnet 22 which passes
20 by a detector 24 which communicates with an interface, which may
21 be a computer, or other monitoring or control device 26, as by a
22 cable 27, and which may include a display screen 28, or other user
23 interface. Alternatively, the computer 26 can be configured to
24 send corrective signals 30 to pumps or valves, or the like (not
25 shown), to modify the flow rate.

1 The fluid flow conduit 12 is provided with an outlet 32 for
2 flowing the fluid downstream of the transducer 20 to a reservoir,
3 such as a tank 34 (FIG. 5) located beneath the module. The outlet
4 32 extends transversely of the conduit 12 and is provided with
5 openings 36, 38 (FIG. 1).

6 The module 10 further includes a housing 40 in which is
7 disposed the conduit 12, a portion of the conduit inlet 14, the
8 conduit outlet 32, and the transducer 20. The housing 40 may be
9 of metal or a rigid plastics material and is provided with opposed
10 first and second walls 42, 44, each having therein one of the
11 openings 36, 38, respectively, for the conduit outlet 32. At
12 least one of the walls 42, 44, and usually both of the walls 42,
13 44, is adapted for stacking engagement with a second fluid flow
14 transducer module 50 which, in turn, is adapted for stacking
15 engagement with a further transducer module 50a (FIGS. 2-5), and
16 so on, with a sufficient number of transducers for a particular
17 application.

18 To aid in quickly assembling the modules 10, 50, 50a, etc.,
19 together, collars 52 are provided for slipping into opposed
20 openings 36, 38. The conduit outlets 32 may be provided with
21 internal projections, such as detents 54 (FIG. 1), for positioning
22 and holding of the collars 52. Alternatively, each of the collars
23 52 may be fixed in, or provided as an integral part of, one of the
24 openings 36, 38, and adapted to enter an opposed one of the
25 openings 36, 38 (FIG. 1A).

1 The uppermost transducer module 10a of an assembly 48 (FIGS.
2 2-5) may be capped so as to close the upper opening 36.
3 Alternatively, if one or more flow transducer modules with inlet
4 and/or outlet connections independent of the common conduit is
5 required, an independent flow transducer module 56 may be
6 assembled in conjunction with other modules to act as an end cap
7 for the adjacent common conduit at the interface with the
8 uppermost fluid flow transducer module 10a. Alternatively, the
9 module 56 may be a "dummy" block having one or more unmonitored
10 channels therein, or may be simply a cap with no channels therein.
11 In like manner, depending upon the function of the assembly 48,
12 there may be an unmonitored module disposed in place of one or
13 more of the modules 10, 10a, 50, 50a. The assembly lower opening
14 38 may be fitted onto a return pipe 58 (FIG. 5) which extends to
15 the reservoir 34.

16 The complete assembly 48 of fluid flow transducer modules and
17 any independent modules may be stacked and locked together by a
18 bar 60 (FIG. 3) which may be provided with appropriate holes
19 therein to permit passage of the transducer cables 27
20 therethrough. The entire assembly 48 may then be placed on the
21 reservoir, as shown by way of example, in FIG. 5. There may be
22 mounted on the reservoir a heat exchanger 62 with appropriate
23 inlet and outlet pipes 64, 66, 68. In FIG. 5, one of the heat
24 exchanger outlet pipes 66 is shown connected to the aforementioned
25 independent fluid flow transducer module 56.

1 It will be apparent that the module shown and described
2 herein may be used in a manner reversed to that set forth above.
3 That is, the module may be used in a manner wherein fluid is
4 ingested by way of pipe 58, which becomes a feed pipe, and flowed
5 through the "outlet" 14, which in this alternative embodiment
6 actually serves as an inlet which distributes the incoming fluid
7 to the various fluid flow conduits 12.

8 The individual fluid flow transducer modules 10, 50 may each
9 be provided with a selected number of fluid flow conduits 12 and
10 associated components of the transducers 20. While each
11 transducer module may be provided with as little as one conduit,
12 it has been found more economical and physically compact to
13 provide two fluid flow conduits 12 per housing 40. Higher numbers
14 of conduits may be used, but may be unduly wasteful if only one or
15 two conduits are needed to complete a manifold.

16 It has been found that modular fluid flow transducer modules
17 as described above can be made quickly and inexpensively and
18 easily stored for future use. When an order is received for a
19 manifold having a specified number of conduits, the required
20 number of transducer modules is fitted and fixed together to form
21 an appropriate fluid flow transducer assembly 48 in short order.
22 In addition to being inexpensively made and time-saving in
23 arranging with other modules, it has been found that servicing is
24 also quick and inexpensive. By removing the bar 60, a faulty
25 module can be removed and replaced without further ado.

1 It will be understood that the present invention is by no
2 means limited to the particular construction herein disclosed
3 and/or shown in the drawings, but also comprises any modifications
4 or equivalents within the scope of the claims. For example, the
5 term "wall" is used in its broadest sense, meaning any boundary
6 layer enclosing a space.